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Citation: Burriss, Robert, Marcinkowska, Urszula and Lyons, Minna (2014) Gaze properties of women judging the attractiveness of masculine and feminine male faces. *Evolutionary Psychology*, 12 (1). pp. 19-35. ISSN 1474-7049

Published by: Ian Pitchford and Robert M. Young

URL: <http://www.epjournal.net/> <<http://www.epjournal.net/>>

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Gaze properties of women judging the attractiveness of masculine and feminine male faces

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Abstract: Most studies of female facial masculinity preference have relied upon self-reported preference, with participants selecting or rating the attractiveness of faces that differ in masculinity. However, researchers have not established a consensus as to whether women's general preference is for male faces that are masculine or feminine, and several studies have indicated that women prefer neither. We investigated women's preferences for male facial masculinity using standard two-alternative forced choice (2AFC) preference trials paired with eye tracking measures, to determine whether conscious and non-conscious measures of preference yield similar results. We found that women expressed a preference for, gazed longer at, and fixated more frequently on feminized male faces. We also found effects of relationship status, relationship context (whether faced are judged for attractiveness as a long- or short-term partner), and hormonal contraceptive use. These results support previous findings that women express a preference for feminized over masculinized male faces, demonstrate that non-conscious measures of preference for this trait echo consciously expressed preferences, and suggest that certain aspects of the preference decision-making process may be better captured by eye tracking than by 2AFC preference trials.

Keywords: Attractiveness, eye-tracking, face, gaze, masculinity, relationship context.

Introduction

To maximize reproductive success, an individual must select a high quality mate (Hopcroft, 2006; Jokela, 2009; Pflüger, Oberzaucher, Katina, Holzleitner, and Grammer, 2012; Prokop and Fedor, 2011). Humans rely on multiple cues to assess the quality and suitability of potential partners; one of the most readily available and useful of these is physical appearance, which provides information about health (Boothroyd, Scott, Gray,

Coombes, and Pound, 2013; Rantala et al., 2013; Rhodes, Chan, Zebrowitz, and Simmons, 2003; Zebrowitz and Rhodes, 2004), personality (Penton-Voak, Pound, Little, and Perrett, 2006), intelligence (Zebrowitz, Hall, Murphy, and Rhodes, 2002), emotional state (Adams and Kleck, 2003) and other characteristics that are considered informative when selecting mates (Little, Jones, and DeBruine, 2011). It is therefore to be expected that individuals attend to the physical appearance of conspecifics, and particularly to characteristics of appearance that signal mate quality, many of which are face-based. When presented with full body erotic or non-erotic images of other-sex persons, both men and women attend more to the face than to the body (Hewig, Trippe, Hecht, Straube, and Miltner, 2008; Tsujimura et al., 2009), and ratings of facial attractiveness more closely mirror ratings of overall physical attractiveness than do ratings of body attractiveness (Currie and Little, 2009; Perilloux, Cloud, and Buss, 2013). As well as attending more to the face than to the body, we pay particular attention to faces we find attractive: women gaze longer at attractive male faces than at faces of average attractiveness (Anderson et al., 2010), perhaps because attractive faces have some hedonic value or because maintaining eye contact signals attraction (Conway, Jones, DeBruine, and Little, 2010; Moore, 1985). It is unclear, however, which aspect of male facial attractiveness drives this difference in attention.

Male facial attractiveness is dependent on multiple variables, with women preferring faces that are bilaterally symmetric, healthy in appearance, and of average shape (Jones, DeBruine, and Little, 2007; Perrett et al., 1999; Rhodes, et al., 2003; Rhodes et al., 2007); it is probable that women's attention is drawn to faces exhibiting these characteristics. Yet, despite much research, the effect of facial masculinity on attractiveness remains ambiguous (Scott, Clark, Boothroyd, and Penton-Voak, 2013). Many studies show that heterosexual women prefer femininity (Berry and McArthur, 1985; Boothroyd, Lawson, and Burt, 2009;

Little, Burt, Penton-Voak, and Perrett, 2001; Little, Jones, Penton-Voak, Burt, and Perrett, 2002; Penton-Voak et al., 2003; Penton-Voak et al., 1999; Perrett et al., 1998; Rhodes, Hickford, and Jeffery, 2000; Welling, DeBruine, Little, and Jones, 2009; Welling et al., 2007), but many others suggest that masculinity is preferred (Boothroyd, et al., 2013; Cornwell and Perrett, 2008; DeBruine et al., 2006; Johnston, Hagel, Franklin, Fink, and Grammer, 2001; Little, Jones, DeBruine, and Feinberg, 2008), or that women prefer neither masculinity nor femininity (Glassenberg, Feinberg, Jones, Little, and DeBruine, 2010; Morrison, Clark, Tiddeman, and Penton-Voak, 2010; Penton-Voak et al., 2001; Rhodes, et al., 2003). It is therefore unclear whether masculinity is attractive, whether consciously expressed preferences for masculinity can be considered valid, and whether we should expect women to attend more to masculine or to feminine male faces.

One method of measuring attention is to track a person's gaze. Eye movements are divided into saccades and fixations (Fromberger et al., 2012): fixations are periods when the fovea—the portion of the retina responsible for sharp central vision—is motionless and visual information is acquired; saccades are rapid eye-movements that occur between fixations and during which images are not acquired (Henderson and Hollingworth, 1999). The length of time a person voluntarily fixates on a stimulus, and the number of fixations they make, can be used as a measure of interest in, or attention to, that stimulus (Võ, Smith, Mital, and Henderson, 2012). Several studies have shown that viewing time is a valid measure of sexual interest in images of people, correlating with genital arousal and self-reports of attraction (Harris, Rice, Quinsey, and Chaplin, 1996; Quinsey, Ketsetzis, Earls, and Karamanoukian, 1996). Eye-tracking has been profitably applied to the investigation of sexual preferences and attention across multiple studies, facilitating the measurement of attention to different body parts, such as the waist, hips, breasts, pubic area, and face (Dixson, Grimshaw, Linklater, and

Dixson, 2011; Dixson, Grimshaw, Ormsby, and Dixson, in press; Suschinsky, Elias, and Krupp, 2007), and to erotic and non-erotic stimuli (Lykins, Meana, and Strauss, 2008). As covert shifts of attention are immediately followed by overt gaze shifts toward preferred stimuli (e.g. Henderson, 1992), and gaze is shifted toward face stimuli that are afterwards chosen as more attractive (Shimojo, Simion, Shimojo, and Scheier, 2003), eye-tracking is a valid tool for investigating autonomic, subconscious, immediate reactions toward mate-choice relevant stimuli, and as such may provide data that are complementary to those drawn from ratings (Krupp, 2008).

Women's masculinity preferences may be facultative, with the relative costs and benefits of associating with typically masculine or feminine men varying according to characteristics of the rater or the context in which faces are judged. Women in the fertile phase of their cycle prefer masculine faces, most likely because copulation that results in pregnancy is the only way to secure heritable benefits of mating with masculine men (for a review, see Jones et al., 2008). The effect of partnership status on masculinity preference has received less attention, but it appears that women who are partnered express a weaker preference for femininity (Little, et al., 2002), a pattern that may indicate a dual-mating strategy whereby women who have secured a long-term partner seek indirect (genetic) benefits by copulating with extrapair masculine men (Larson, Haselton, Gildersleeve, and Pillsworth, 2013). Furthermore, it is hypothesized that women should value femininity in a long-term partner, since feminine men are perceived as more cooperative, honest, emotionally warm, and better parents (Perrett, et al., 1998), and may therefore prove more suitable long-term partners than masculine men. However, when women judge men's attractiveness for long-term and short-term relationships, responses are variable: women sometimes express a stronger preference for masculinity (or a weaker preference for

femininity) when judging for short- rather than long-term relationships (Little, Connely, Feinberg, Jones, and Roberts, 2011; Little, et al., 2002), but researchers have also reported no main effect of relationship context on facial masculinity preferences (e.g. Little, et al., 2001; Penton-Voak, et al., 2003).

We might predict that there are effects of status and context on attention to masculine faces that correspond with known effects of these variables on masculinity preference. Although Anderson, et al. (2010) did not directly consider masculinity, they did show that women's visual attention to attractive men peaks during the fertile phase of the cycle. In addition, Rupp et al. (2009) have shown that single women spend more time than partnered women fixating images of men, which may indicate greater implicit interest among the former group. It remains unknown, however, whether women attend differently to masculine faces according to partnership status or relationship context.

Hormonal contraceptives (HCs) influence women's mate preferences. In every study of phenotypic variation over the ovulatory cycle in which users and non-users have been separately tested, effects present in non-users have been absent in users (Frost, 1994; Gangestad and Thornhill, 1998; Guéguen, 2009; Laeng and Falkenberg, 2007; Penton-Voak, et al., 1999; Puts, 2005). Recent research indicates that male partners of HC users are more facially feminine than those of non users, and that, once women start using an HC, their preference for male facial masculinity decreases (Little, Burriss, Petrie, Jones, and Roberts, 2013). Furthermore, Rupp and Wallen (2007) have shown that women viewing sexually explicit images fixate significantly longer on clothing and background information if they are users rather than non-users of HCs, signifying reduced interest among users in the sexual components of stimuli. It would therefore be appropriate to test for the effects of HC use on women's attention to facial masculinity.

One recent study has shown that people generally attend more to masculine than to feminine male faces, with significantly longer first fixations in response to masculinized images (Wen and Zuo, 2012). A replication of this study is necessary because Wen and Zuo recruited both male and female participants but did not test for effects of participant sex; hence it is not possible to determine whether their results are driven by men's or women's perceptions. Testing for effects of participant sex, or recruiting only female participants, is necessary for conclusions to be formed about facial masculinity and mate-preference.

We tested whether single and partnered (and HC using and non HC using) women's preference for and attention to male faces that differ in masculinity vary when attractiveness is judged for long- and short-term relationships. We predicted that women's preference for masculinity and their attention to masculine faces would be greater if they were partnered, when they judged attractiveness for short- rather than long-term relationships, and if they were non HC users. Given previous equivocal findings with respect to overall masculinity preferences, we made no predictions as to whether women would generally prefer or attend more strongly to feminine or masculine faces.

Materials and Methods

Stimuli

We randomly selected neutral facial photographs of 25 White men (mean age = 21.04 years, $SD = 2.26$) from a pool of photographs of 88 male undergraduate students (or male partners of undergraduate students), recruited at a large northeastern American university. We excluded images in which the man wore a heavy beard that concealed his jaw line, but did not exclude images due to light facial hair. We rotated and scaled these images so that pupils lay on a horizontal line and interpupillary distance was constant. We then transformed

each image by $\pm 50\%$ of the shape differences between symmetrical male and female prototypes using standard computer graphics methods (e.g. DeBruine, et al., 2006; Little, et al., 2001; Welling et al., 2008). Prototypes were made by averaging the face shape of 60 White undergraduate aged men/women, who were photographed with a neutral expression and without glasses or facial jewelry. For convenience, $+50\%$ transforms will hereafter be labeled masculinized, and -50% transforms, feminized. This type of transformation produces photorealistic images that independent raters perceive as differing in masculinity (DeBruine, et al., 2006; Welling, et al., 2007). We obscured hair, neck, and clothing with a mid-gray solid mask (see Figure 1), because studies show that non-face information can affect facial masculinity preferences (DeBruine, Jones, Smith, and Little, 2010; Wen and Zuo, 2012).

Figure 1. Example of a feminized (left) and masculinized (right) male face.



Participants

Participants were 93 women (86 reported age: mean = 20.42 years, SD = 3.77), recruited at a university in the UK's northwest. Forty one women were single and 44 were

partnered (eight did not respond). Forty eight used an HC (pill, implant, etc) and 38 did not (seven did not respond). One participant's gaze was not tracked during the long-term attractiveness task due to a tracking calibration error.

Procedure

Participants attended one laboratory session. Each completed a demographic questionnaire including items on age, relationship status (single/partnered), and HC use (user/non-user), as well as two facial masculinity/femininity preference tasks (long- and short-term attractiveness judgments). Before beginning the tasks, participants read long- and short-term relationship definitions (see e.g. Little, et al., 2013; Little, Cohen, Jones, and Belsky, 2007; Penton-Voak, et al., 2003). These definitions were also given verbally by a researcher.

Gaze was tracked during the preference tasks. We asked participants to remain as motionless as possible; head movement was limited by use of a chin and forehead rest. The procedure for the preference tasks was similar to that used in previous studies (e.g. DeBruine, et al., 2006; Little, Connely, et al., 2011). Male face pairs were presented on screen and participants judged the faces for attractiveness for long- and short-term relationships. Task order was counterbalanced, with half of the participants completing the long-term task first and the remainder, second. During each task participants saw 25 pairs of faces, each consisting of a masculinized and feminized transform of the same face. Pairs were presented in a different random order for each participant. The side of the screen on which each image appeared was also randomized. Trials were preceded by a blank screen for 1000 ms. During a presentation period of 4000 ms, participants were unable to respond. After 4000 ms had elapsed, the response period began and tracking for that trial ceased. A message reading

“please select” appeared on screen above the images, and the participant indicated which image they preferred by clicking the left or right button on a handheld control pad. The response period continued until the participant responded, when the sequence began anew for the next trial. We calculated the proportion of feminized faces preferred by each participant in each of the two tasks. A score of 1 indicates that the feminized face was always preferred, and a score of 0 that it was never preferred.

Using the EyeLink 1000 eye tracker (SR Research), we recorded first fixation duration, total fixation duration, and fixation count during each trial. We considered a fixation as such if the participant gazed at an image for any period of time. However, this model of eye tracker records data at 1000 Hz, so we would typically expect to register only those fixations $> \sim 7$ ms. We defined first fixation duration as the number of milliseconds the participant fixated on the masculinized / feminized face the first time they fixated on it, with a maximum of 4000 ms; total fixation duration as the summed duration of all fixations on the masculinized / feminized face, again to a maximum of 4000 ms; and fixation count as the total number of times the participant fixated on a different area of the masculinized / feminized face. The measures were averaged across all trials, giving participants four scores on each dependent variable (for masculine/feminine faces in the long-/short-term task).

Statistical analyses

We used t-tests to ascertain whether women’s overall preference was for masculinized or feminized faces, and 2 (relationship context) x 2 (participant relationship status) x 2 (participant HC use) mixed analysis of variance (ANOVA) to explore the effects of the independent variables on masculinity preference. Next, we used 2 (stimulus masculinity) x 2 (relationship context) x 2 (participant relationship status) x 2 (participant HC use) mixed

ANOVAs to test for effects on each of the three gaze measures. All p-values are two-tailed and considered statistically significant if $p < .05$.

Statement of ethical treatment of participants

This research was approved by the Liverpool Hope University Department of Psychology IRB. Stimulus image photography was approved by the Pennsylvania State University Office of Research Protections IRB. Sitters consented to the use of their facial photographs in future research.

Results

Femininity preferences

One-sample t-tests against chance (0.5) revealed overall preferences for femininity over masculinity in the long-term, $t(92) = 6.05$, $p < .001$, $r = .53$, and short-term relationship contexts, $t(92) = 4.74$, $p < .001$, $r = .44$. Women did not vary in their preference for femininity as a function of context, $F(1, 81) = 1.08$, $p = .30$, relationship status, $F(1, 81) = 0.01$, $p = .91$, or HC use, $F(1, 81) = 0.02$, $p = .90$. There was no significant interaction between status and HC use, $F(1, 81) = 1.88$, $p = .17$. However, the interaction between context and status was significant, $F(1, 81) = 4.01$, $p = .049$, $\eta_p^2 = .047$. Post hoc t-tests indicated that the long-term ($M = .61$, $SD = .27$) and short-term ($M = .65$, $SD = .24$) preferences of single women did not differ, $t(40) = 0.87$, $p = .39$. However, partnered women's preference for facial femininity was significantly higher in the long-term ($M = .66$, $SD = .20$) than the short-term context ($M = .58$, $SD = .24$), $t(43) = 2.06$, $p = .046$, $r = .30$. There was no significant difference between single and partnered women in the long-term, $t(83) = 1.02$, $p = .31$, or short-term contexts, $t(83) = 1.41$, $p = .16$.

The interaction between context and HC use was close to significance, $F(1, 81) = 3.69$, $p = .058$. The long-term ($M = .61$, $SD = .24$) and short-term ($M = .64$, $SD = .22$) preferences of HC users did not differ, $t(47) = 0.60$, $p = .56$. The difference between the long-term ($M = .67$, $SD = .22$) and short-term ($M = .58$, $SD = .26$) preferences of non HC users was close to significance, $t(37) = 1.93$, $p = .062$, indicating that women who are non users of HC may be more attracted to femininity when judging men for long- rather than short-term relationships. There was no significant difference between HC users and non users in the long-term, $t(84) = 1.09$, $p = .28$, or short-term contexts, $t(84) = 1.15$, $p = .25$.

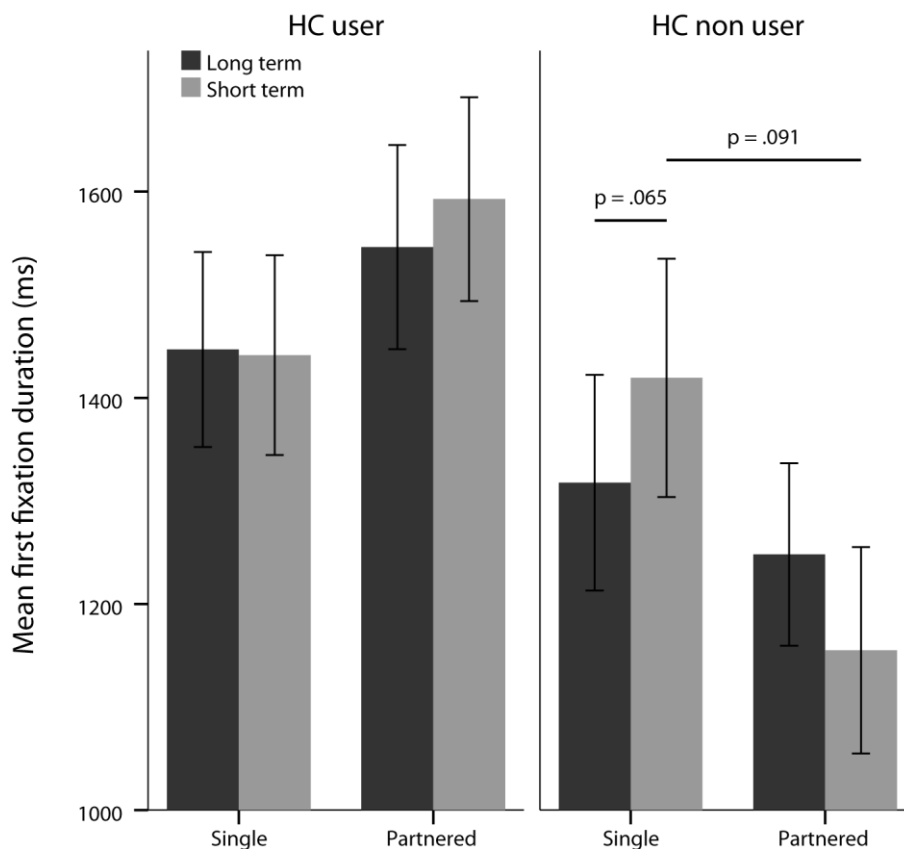
First fixation duration

We observed no significant effect on first fixation duration of facial masculinity, $F(1, 80) = 1.66$, $p = .20$, relationship context, $F(1, 80) = 0.17$, $p = .69$, or relationship status, $F(1, 80) = .047$, $p = .83$. The effect of HC use was significant, $F(1, 80) = 5.37$, $p = .023$, $\eta_p^2 = .063$, with HC users tending toward longer first fixations.

The three-way interaction between context, status, and HC use was significant, $F(1, 80) = 4.09$, $p = .046$, $\eta_p^2 = .049$ (see Figure 2). To interpret the interaction, we conducted separate analyses for HC using and non-using women: the interaction between context and status was not significant for HC using women, $F(1, 44) = 0.36$, $p = .55$, but it was significant for non HC users, $F(1, 36) = 5.45$, $p = .025$, $\eta_p^2 = .13$. Paired t-tests showed that non HC using partnered women did not differ in their first fixation as a function of context, $t(19) = 1.45$, $p = .16$. The effect of context on first fixation duration in non HC using single women was near to significance, $t(17) = 1.97$, $p = .065$. Independent t-tests showed that, in non HC using women, there was no effect of status on first fixation duration in the long-term context, $t(36) = .51$, $p = .61$; the effect in the short-term context was close to significance, $t(36) =$

1.74, $p = .091$. Therefore, there may be a trend for non HC using women to first fixate for longer when making a short-term rather than a long-term attractiveness judgment if they are single but not if they are partnered, and for single women to fixate longer during the short-term judgment than their partnered peers.

Figure 2. Mean first fixation duration, split by HC use, partnership status, and relationship context. For reasons of clarity, and because the three-way interaction this graph illustrates does not include facial masculinity, data for masculinized/feminized faces are combined. Also note that the Y-axis begins at 1000 ms.

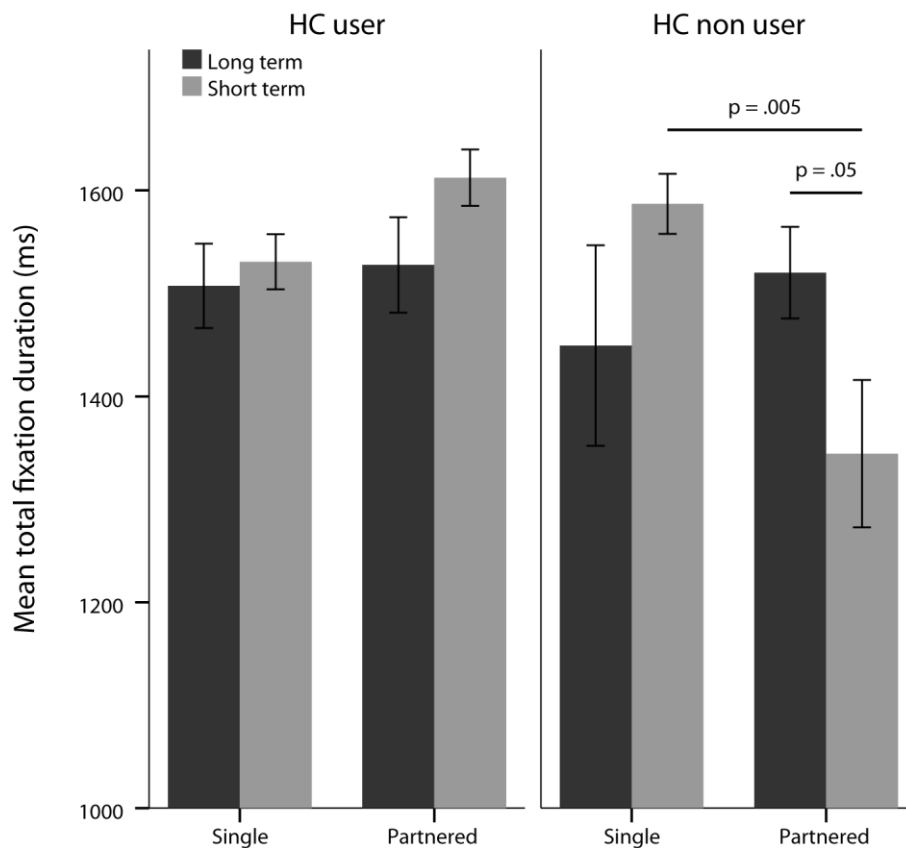


Total fixation duration

For total fixation duration, we found a main effect of facial masculinity, $F(1, 80) = 26.59$, $p < .001$, $\eta_p^2 = .25$, with longer fixation on feminine ($M = 1560$ ms, $SD = 223$) than on

masculine faces ($M = 1424$ ms, $SD = 226$). There was no main effect of relationship context, $F(1, 80) = 0.28$, $p = .60$, or relationship status, $F(1, 80) = 0.21$, $p = .65$. The main effect of HC use was close to significance, $F(1, 80) = 3.26$, $p = .075$, with longer fixation by HC users ($M = 1541$ ms, $SD = 156$) than non users ($M = 1473$ ms, $SD = 199$).

Figure 3. Mean total fixation duration, split by HC use, partnership status, and relationship context. Data for masculinized/feminized faces are combined. Also note that the Y-axis begins at 1000 ms.



The three-way interaction between context, status, and HC use was significant, $F(1, 80) = 7.92$, $p = .006$, $\eta_p^2 = .090$ (see Figure 3). To interpret the interaction, we conducted separate analyses for HC using and non-using women: the interaction between context and

relationship status was not significant for HC using women, $F(1, 44) = 1.54$, $p = .22$, but it was significant for non HC users, $F(1, 36) = 5.47$, $p = .025$, $\eta_p^2 = .13$. Paired t-tests showed that non HC using single women did not differ in their first fixation as a function of context, $t(17) = 1.30$, $p = .21$. The effect of context on first fixation duration in non HC using partnered women was near to significance, $t(19) = 2.09$, $p = .05$. Independent t-tests showed that, in non HC using women, there was no effect of relationship status on first fixation duration in the long-term context, $t(36) = 0.68$, $p = .50$; the effect in the short-term context was significant, $t(36) = 3.02$, $p = .005$. Therefore, partnered non users of HC fixate for longer on the faces (regardless of masculinity) during the long-term than the short-term task, and for less time overall during the short-term task than their single peers.

Fixation count

For fixation count, we observed a main effect of facial masculinity, $F(1, 80) = 44.49$, $p < .001$, $\eta_p^2 = .36$, with more frequent fixations on feminine ($M = 6.31$, $SD = 1.28$) than on masculine faces ($M = 5.84$, $SD = 1.24$). There was no main effect of context, $F(1, 80) = 0.13$, $p = .72$, relationship status, $F(1, 80) = 0.07$, $p = .79$, or HC use, $F(1, 80) = 0.41$, $p = .13$.

The context and status interaction was significant, $F(1, 80) = 9.68$, $p = .003$, $\eta_p^2 = .11$. Separate analyses indicated that the effect of context was significant for single, $F(1, 38) = 5.27$, $p = .027$, $\eta_p^2 = .12$, and for partnered women, $F(1, 42) = 4.34$, $p = .043$, $\eta_p^2 = .094$. Single women fixated more frequently during the short-term ($M = 6.22$, $SD = 0.96$) than the long-term context ($M = 5.89$, $SD = 1.42$), while partnered women exhibited the opposite pattern, with more frequent fixations during the long-term ($M = 6.26$, $SD = 1.30$) than the short-term context ($M = 5.99$, $SD = 1.51$).

Discussion

This study demonstrates that women attend more to, and prefer, feminine over masculine male faces. Our results do not replicate those of Wen and Zuo (2012), which show that participants attend more to masculine faces, as measured by first fixation duration. The main effect of masculinity on first fixation duration was null. We instead identified effects of masculinity on total fixation duration and fixation count, with longer and more frequent fixations in response to feminine rather than masculine faces. Our methods and those of Wen and Zuo are similar, so it is unlikely that this disparity is due to how our stimuli were created or presented. We note that we recruited only female participants, while Wen and Zuo combined data from male and female participants, and so our results are not strictly comparable. Men may attend more to masculine than to feminine male faces because masculine men are perceived as more dominant (e.g. Main, Jones, DeBruine, and Little, 2009), and may therefore represent more competitive rivals (Puts, 2010). Only by focusing analysis on heterosexual women—or by testing for effects of participant sex—can we draw conclusions about facial masculinity and attractiveness.

The finding that women attend more to feminine than to masculine male faces supports previous findings that heterosexual women express an overall preference for feminine male faces (e.g. Perrett, et al., 1998; Welling, et al., 2009), although there is much evidence that women prefer masculinity (e.g. DeBruine, et al., 2006) or have a preference for neither masculinity nor femininity (e.g. Glassenberg, et al., 2010; Morrison, et al., 2010). Most preference studies employ a 2AFC or an individual rating paradigm, whereby participants indicate which of two faces they prefer or the extent to which they like a single face by typing/clicking a response. It could be argued that studies such as ours, which

measure proxies of preference less likely to be under conscious control, namely fixation duration and frequency, give a more accurate representation of preference (Rupp, et al., 2009). However, our measures of gaze and of conscious preference produced similar results (preferences for / attention to femininity); we cannot be certain that, had previous investigators who report a conscious preference for masculinity also incorporated measures of gaze direction, findings from both measures would be congruent. Because studies of masculinity preference with similar designs have produced different findings, we do not recommend that researchers simply replicate previous studies that have shown women prefer masculinity and incorporate measures of gaze direction to determine whether, in these instances, women attend more to masculine faces. A preferable alternative would be to test for differences in attention to masculine and feminine faces as a function of participant attractiveness or cycle phase, because multiple studies have established that women higher in attractiveness, or nearer to ovulation, consistently express stronger preferences for masculinity in faces and other modalities (e.g. Feinberg et al., 2012; Little, et al., 2001; Little and Jones, 2012; Penton-Voak, et al., 2003; Penton-Voak, et al., 1999; Puts, 2005; Smith et al., 2009; Vukovic et al., 2010).

Researchers have theorized that women should prefer masculinity under circumstances in which the benefits of mating with men with good genes are thought to be high, such as when women are partnered or when they are seeking a short- rather than a long-term partner (e.g. Little, et al., 2002). Studies of context-dependent preferences have produced mixed results, and our findings—that women do not vary in their preference for femininity as a function of relationship status or context—mirror some previous findings (Little, et al., 2001; Penton-Voak, et al., 2003). There is some evidence that partnered women prefer masculinity (Little, et al., 2002), although we found no main effect of partnership

status on preference. We did, however, find an interaction between context and status on preference, such that partnered women prefer femininity when judging men's attractiveness for long- rather than short-term relationships, which is consistent with previous findings.

We also found three-way interactions between context, relationship status, and HC use for first fixation and total fixation duration, and a two-way interaction between context and status for fixation count. Post-hoc analyses suggested that status and context do not affect first fixation duration in HC using women. However, in non HC using women there is a trend for single (but not partnered) women to fixate longer during the short-term than the long-term context, and for single women to fixate longer during the short-term (but not long-term) context than partnered women. We interpreted the interaction for total fixation duration similarly, except that there was a trend in non HC using partnered (but not single) women to fixate longer during the short-term than the long-term context. It is difficult to account for the difference between these two patterns, although we note that post-hoc analyses for first fixation data revealed effects that did not meet the conventional criterion for statistical significance. We are therefore more confident that the effects on total fixation duration are genuine. Because the three-way interaction did not include facial masculinity, women are not fixating longer on masculinized or feminized faces as a function of status or context. Rather, single women fixate longer in general than partnered women when making short-term judgments. This could indicate that single women are more engaged in the task than partnered women, who in turn fixate longer when judging long-term rather than short-term attractiveness.

The interaction between status and context on fixation count was of a similar pattern, such that single women fixated more frequently during the short-term task, whereas partnered women fixated more frequently when judging long-term attractiveness. Because the

interaction did not include facial masculinity, this is further evidence that women's context- and status-dependent attention to men's faces is independent of facial masculinity. These patterns of results may be explained by partnered women finding it more difficult to express a preference when judging for a long-term partner, whereas single women find the task more demanding when judging for a short-term partner. This is what we would expect to see if single women are primed to seek a long-term partner whereas partnered women, having already secured a long-term partner, are primed to seek short-term extrapair partners (Little, et al., 2002). An inability to express a preference could be manifested as longer attention to the images and more changes in attention as images or image areas are compared. This pattern of behavior would drive up the overall fixation count for both images, without affecting measures of gaze duration or of consciously expressed preference. When women find the task easier and are able to decide upon a preferred face after a shorter period of time, the tendency to attend longer or to shift attention repeatedly might be lower.

This interpretation might also explain why we found that HC using women gazed for a longer time than non HC using women (although they did not fixate more frequently). Hormonal contraceptives, such as the contraceptive pill, influence mate preference and mate choice (Alvergne and Lummaa, 2010; Little, et al., 2013; Roberts et al., 2012). Because HCs maintain hormone concentration at levels roughly representative of the late phase of the natural ovulatory cycle, we predicted that women who use HCs would express stronger preferences for, and attend more closely to, feminine male faces; our results did not support this hypothesis. Again, it may be that HC users find the task more demanding, or that they are generally more attentive to men than non HC users. The effects on libido of oral contraceptives, the most commonly used form of HC, are unclear, although retrospective studies generally suggest higher sex drive among users (Davis and Castaño, 2004). Women

whose sexual desire is stronger exhibit longer response times when judging sexual stimuli (Conaglen and Evans, 2006), which would be consistent with our finding that HC users fixate longer than non users on male faces, although there is also evidence that oral contracepting women fixate less on genitals when viewing sexual stimuli than do non users of oral contraceptives (Rupp and Wallen, 2007). Future research might test for independent effects of sex drive, sociosexual orientation, and HC use on women's attention to male faces.

Previous research has established that women attend more closely to faces they find attractive (Anderson, et al., 2010). Nevertheless, it remains unclear whether women generally prefer masculine or feminine faces. Although our results demonstrate that women attend more to feminine faces, and that attention is influenced by women's relationship status, hormonal contraceptive use, and the relationship context under which men are judged, future research should seek to establish whether, in other circumstances where we would expect women to prefer masculine faces, attention to feminine faces falls in favor of the masculine.

Acknowledgements: The authors express their gratitude to B. Zuo for answering our questions about Wen and Zuo (2012), M. Guest for technical assistance, and L. Nxumalo and M. Fox for assisting with data collection. They also thank D.I. Perrett and B.P. Tiddeman for permitting use of the Psychomorph program.

Received 6 April 2013; Revision submitted 2 December 2013; Accepted 3 December 2013

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